J. Gill.

Bridge Beam.

No. 89,400. Patented Apr. 27, 1869.

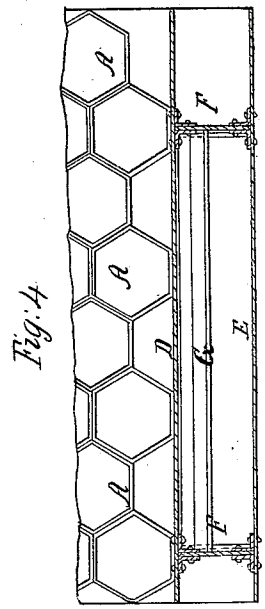

Fig. 4

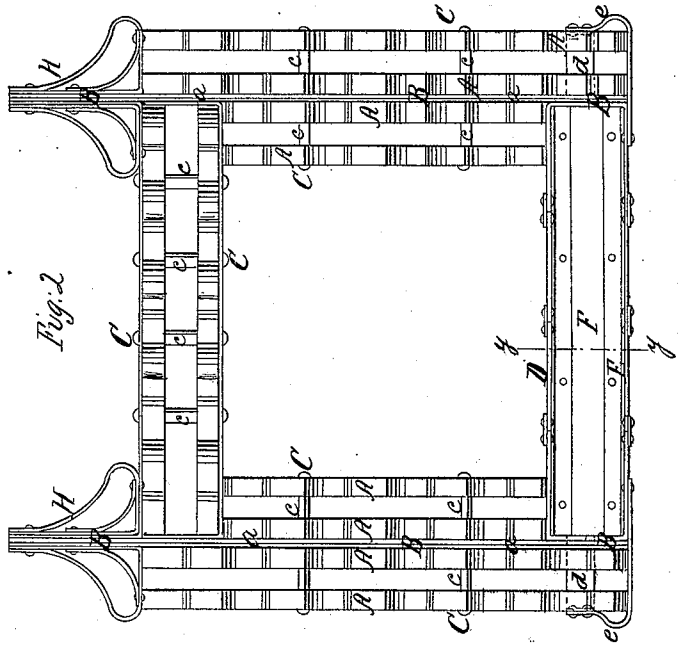

Fig. 2

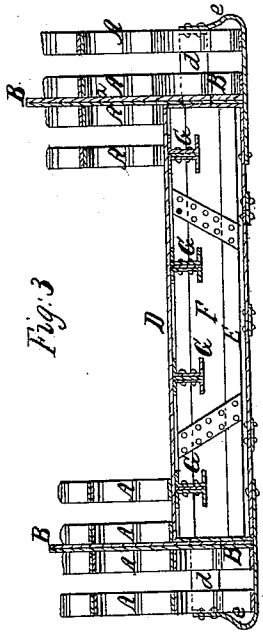

Fig. 3

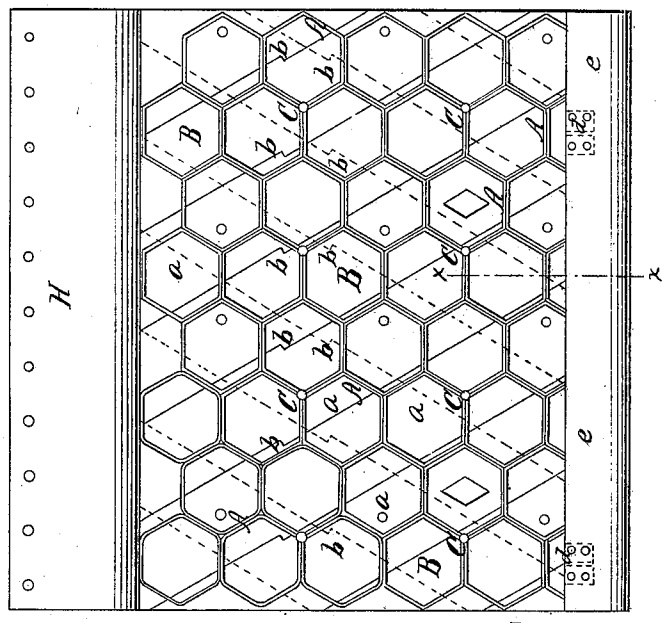

Fig. 1

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JOSEPH GILL, OF CINCINNATI, OHIO.

Letters Patent No. 89,400, *dated April* 27, 1869.

IMPROVED METALLIC BEAM AND GIRDER FOR BRIDGES.

The Schedule referred to in these Letters Patent and making part of the same.

To all whom it may concern:

Be it known that I, JOSEPH GILL, of Cincinnati, in the county of Hamilton, and State of Ohio, have invented a new and useful Improvement in Metallic Beams, Girders, and Frames, Applicable to the Construction of Bridges, Buildings, and other Structures; and I do hereby declare that the following is a full, clear, and exact description thereof, which will enable those skilled in the art to make and use the same, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 represents a side elevation of my improved cellular frame.

Figure 2 is an end elevation of a tubular bridge, constructed on my improved plan.

Figure 3 is a detail vertical transverse section of the lower part of the same, the plane of section being indicated by the line *x x*, fig. 1.

Figure 4 is a detail longitudinal section of the lower part of the same, taken on the plane of the line *y y*, fig. 2.

Similar letters of reference indicate corresponding parts.

This invention relates to a new manner of constructing metallic beams, girders, or frames, particularly applicable to bridges, and to walls, partitions, or floors of buildings.

The great desiderata required in metallic girder-bridge structures are ample and superabundant strength, to resist the immense tensile and compressive forces called into action when such bridges are built of wide span, and carrying, besides their own weight, that, for instance, of an immense throng of people, filling up and rapidly passing over in a compact moving column, such contingencies frequently occurring at or near large towns, or in the vicinity of populous communities.

In such cases not only is great tensile and compressive resistance necessary, but also excessive lateral stiffness or rigidity required to resist vibrations caused by such aforesaid circumstances, as also by heavy storms, or rapidly-traversing railway-traffic.

But few of these conditions appear to have been satisfied in any of the recently-built bridges, except, perhaps, the tubular bridges in Wales, and that in Canada.

In all systems of iron-trussed work in bridges, when all the parts are screwed up to their bearings, at any temperature, any after-variations, by increased heat or cold, should so lengthen or shorten the parts as to keep them all at an equal intensity of tensile or compressive strain. Otherwise some of its parts are relieved at the expense of other portions, which are thus overtasked; hence, the tendency to the sagging or warping and endangering of the structure; and worse than this is the fact that such combinations are generally dependent for their safety upon the reliability of probably a pair of legs, rods, or braces in every part of the bridge, which is a condition highly objectionable, as in the case of a heavily-laden passenger-train passing over such a bridge when the fracture referred to would possibly sacrifice human life, and that to a lamentable extent.

The construction of wrought-iron girder or tubular bridges upon the principles involved in my invention, would be characterized by a uniform simplicity and a reliable strength and safety, because a number of iron beams, composed each of probably ten times the number of pieces of iron or steel, would have to be simultaneously snapped through before a break-down of such a bridge could occur.

Then, there are two other highly recommendable features about the principles upon which my bridges are built that, by deepening the girders, strength can be insured, and the strength of the bridge also increased directly by the increase of the number or strength of its parts, without necessitating greater height or width of the bridge, and consequent great weight of metal.

My invention consists, first, of the adoption of one, two, or more series of polygonal or circular cells A A, (preferring those of a hexagonal shape,) formed out of flat bars of wrought-iron, steel, or other metal, with the ends, when turned into shape, either welded together or left meeting in a but-open joint, and having each of their sides perforated, by punching or drilling, with one, two, or more holes, for the reception of rivets or screw-bolts, to fasten them together, said cells, when so united, forming a rigid beam of metal, and which beams may be so built up to any height as to obtain any desired strength. These cells are fully shown in fig. 1, and edge views in fig. 2. In the latter figure it is shown that more than one row or wall of such cells can be used, four being shown on each side of the bridge, and two on top.

My invention further consists in constructing a partition, B, of iron, steel, or other metallic plates, *a a*, all arranged in a diagonal or lattice-like position at an angle of about sixty degrees, over any desired extent of surface, each of said plates being provided, near the middle of each of its two longest parallel edges, with a step, *b*, of one to one and a half inch in width.

When the plates are brought in contact with each other, their respective steps will overlap, as shown in fig. 1.

A partition of such diagonal plates, I prefer to have made of two thicknesses, as is clearly shown in figs. 2 and 3, the plates in the inner thicknesses being arranged as those herein described, but in a reverse direction, as indicated by dotted lines in fig. 1.

The two thicknesses are then to be riveted together, to bring all the edges, steps, and sides close together, thus forming one united rigid plate-beam of any length, depth, and strength required.

My invention further consists in applying one or more of said hexagonal, or other cell-beams A to each

of the two sides of said plate-beam B, and in connecting them by means of rivets, or screw-bolts C, through every other angle of each beam of cells A, as shown in fig. 1. These rivets are applied through holes drilled through the central, or plate-beam B, and through spaces left between three adjoining cells. All parts are thus united into one complete compound cellular frame-beam or girder, as first herein referred to.

Any number of the said single cellular beams A, or of the compound cellular plate-beams A B, may be placed, side by side, together, or at any suitable distance apart, by means of washers *c c*, fitted around the rivets, or bolts C, that pass through all the thicknesses of frames, as shown in fig. 2.

My invention further consists in the application to bridges of more than two hundred and fifty feet span, or, in cases where very great strength, combined with excessive rigidity, is required, of a chest-like form of roof and floor, in combination with two of the said combination cellular plate-girders, for the sides to form a tubular bridge, as in fig. 1.

The said chest-floor being formed out of two series of metallic plates D E, covered with double-riveted plates over the joints, and the ends of said plates being returned square against and riveted to the central plate-beams B of the girders, as shown in fig. 3, as also to the bottoms of the four inner cell-beams A.

There will also be minor plate floor-joists G placed at proper distances between every two main floor-beams F, that support the upper plate D, as shown.

The joists G are, by wide angle-gussets at their ends, riveted to the main floor-beams F, and to the upper series of floor-plates, the whole floor, and constituent parts of iron, or other metal, being thus doubly secured to the sides of the tube, and offering the most material resistance to the longitudinal tension on the lower portions of the structure.

By means of straps *d d* the plate-beam B is also connected with curved foot-plates *e*, as shown.

My invention further consists of an improved form of treble-plate metallic cap, or caps H, folded together, as per drawing, and fixed upon and riveted to the tops of the cellular or cellular and plate-beams, to stiffen and render them more capable of resistance to the crushing strain exerted upon those parts.

In all cases where bridges are constructed, either by the adoption of the simple cell-beams, or of the cell in combination with central plate-beams, the terminating ends of such beams or girders, where they rest upon the abutment or supporting walls of the structure, will require that a vertical plate or plates of cast-iron be placed there, on each side, also one at right angles thereto, to cover the ends of such beams with a foot-plate, to clip and receive them, and be united by rivet or screw-bolts thereto, so constructed as to allow a little play lengthwise, for expansion or contraction by changes of atmospheric temperatures; and in bridges of more than one hundred feet span, an additional and separate wall-plate, fitted with metallic rollers, should be also placed under each end of said girders, more properly to provide for such expansions or contractions, which have doubtless, when some such arrangements have been omitted, caused the deforming and destruction of many iron bridges.

My invention finally consists in the application of such hereinbefore-recited cellular and combined cellular and plate-beam arrangements, for the sides, floors, and roofs of fire-proof and other buildings, jails, or such other structures requiring great strength and security against fire or attempts at penetration.

The plate-beams, of wrought-iron or steel, resisting penetration, and the cellular addition supplying the necessary rigidity, and also affording the means, when the cell-bars are rolled with small studs on their surface, or one of their sides, of receiving and firmly retaining a filling in of a non-conducting composition of plaster, to form an artificial stone, to finish the surfaces, and prevent injurious effects to the iron framework by heat from the ignition of the contents of any room or building so constructed.

I do not claim the invention of hollow metallic tubular girders, as such were patented by Fairbairn, in England, upwards of twenty years since; neither do I claim the invention of tubular bridges, as such have been long ago erected, as in the Britannia bridge in Wales, and that over the St. Lawrence in Canada, both built with iron or boiler-plate, and stiffened by vertical ribs of angle L and T-iron; neither do I claim the adoption of cells in the roof or floor of such bridges, constructed with plates of iron, connected by angle-irons, as adopted by Stephenson in the Britannia bridge; but

What I do claim as my invention, is—

1. The cellular beam A, built up or constructed out of metallic bars of any regular geometrical figure, riveted or bolted together, substantially as set forth.

2. The metallic plate-iron beams B B, composed of plates that are arranged either vertically or obliquely in lattice-shape, and that have steps *b b* on their edges, as set forth, so that they can be fitted together, the said beam being made of one or more thicknesses of such plates with crossed joints, as specified.

3. The combination of said cellular and plate-beams into a compound cellular and plate-girder, substantially as herein shown and described.

4. The cellular structures in the roof of the bridge, held apart by the distance columns, in combination with the cellular sides and step-plates, substantially as described, for the purpose specified.

5. The treble-plated folded cap-plates H, constructed and applied as herein set forth and shown.

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Witnesses:

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